REPORT TO THE BOARD OF TRUSTEES

ON THE

ALBERTA GOVERNMENT - OIL SANDS PROJECT

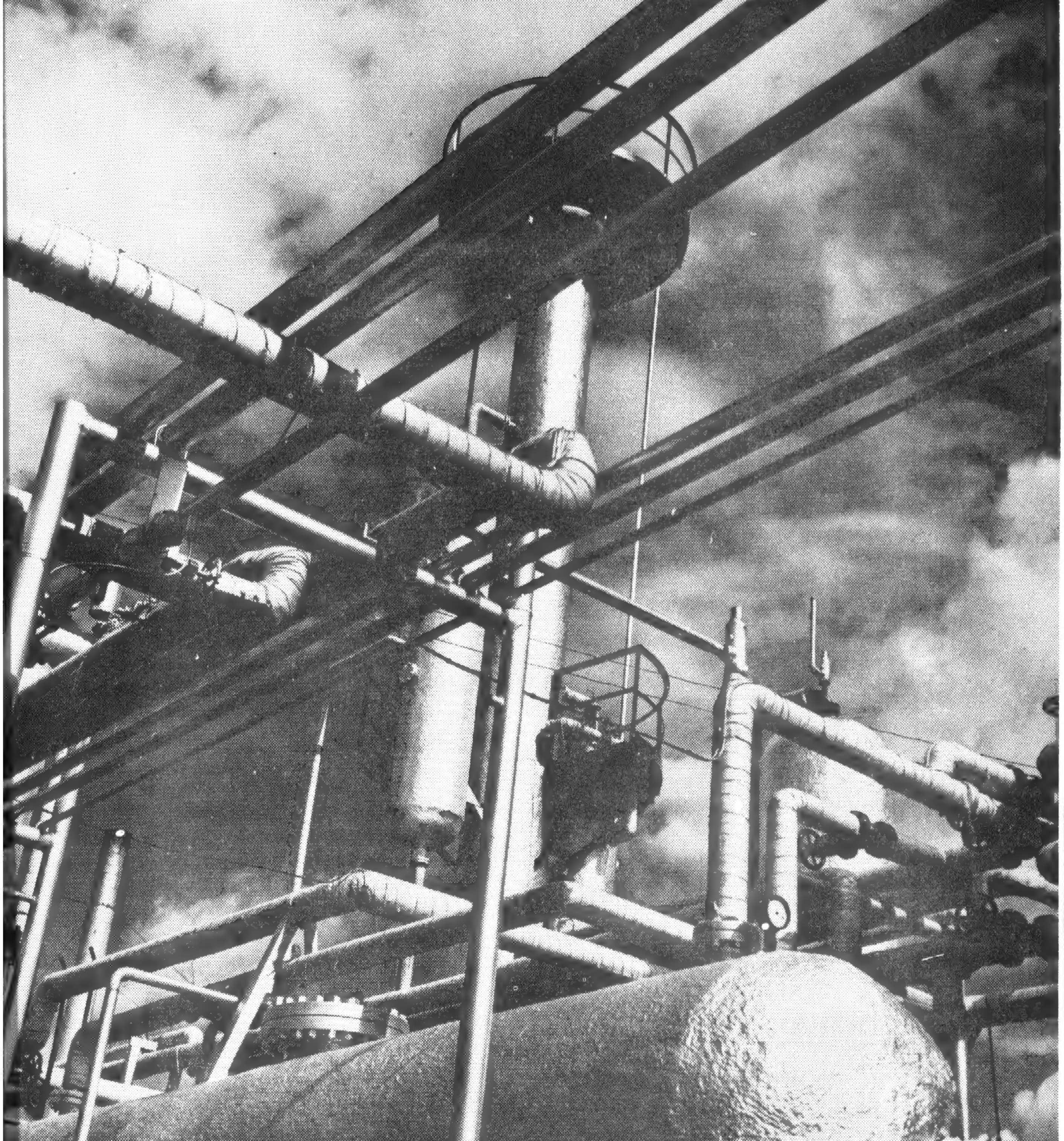
FROM

JANUARY 1, 1949 - DECEMBER 31, 1949.

PREPARED BY

THE OIL SANDS PROJECT STAFF

Alberta: Oil Sands Project



FOREWORD

The purpose of this report is to give the Board of Trustees of the Alberta Government Oil Sands Project a detailed account of the activities on the Project during 1949.

An attempt has also been made to include sufficient operating data to make the report more generally useful.

W. E. ADKINS.

ALBERTA GOVERNMENT
OIL SANDS PROJECT.

INTRODUCTION

It will be recalled that after a brief period of operation in the fall of 1948 several operating difficulties developed. This was not unexpected since little data on certain points had been available for design purposes. It was felt, however, that sufficient information had been gained to permit rectification of these difficulties and consequently it was decided to shut the plant down immediately rather than risk possible damage to the equipment while struggling with mechanical problems during cold weather.

Accordingly operations were suspended on October 22, 1948 and all necessary precautions taken to prevent damage to plant equipment, piping, etc. during the winter months. Two watchmen were retained to comply with insurance regulations and the balance of the crew were flown out on November 4, 5, & 6, using one of the Government aircraft.

On November 12 a meeting was held in the office of the Hon. D.B. MacMillan to give further consideration to our proposed course of action. This meeting was attended by members of the Board of Trustees and representatives of the Alberta Research Council in addition to all members of the staff of the Oil Sands Project.

At this meeting it was decided that W.E. Adkins should arrange to meet with representatives of the Born Engineering Company and of Link-Belt Limited. It was further decided that prior to these meetings it would be desirable for Mr. Adkins to visit a large mine mill to study methods and equipment being used there as their problem seemed more closely analogous to those encountered on the Oil Sands Project, than did those of any other industry.

As the first step in carrying out these decisions, Mr. Adkins spent several days at the Sullivan Concentrator of the Consolidated Mining and Smelting Company at Kimberly, B.C. This trip proved most useful and informative.

Arrangements were then made by Dr. Sidney Born for all those who had worked on the engineering design to attend at conferences in his offices in Tulsa on November 30 and December 1, 2, and 3, 1948. The following people were present at these meetings.

Dr. Sidney Born	- Born Engineering Company.
Mr. H. J. Born	- " " "
Mr. J. H. Markham	- " " "
Mr. K. W. Anderson	- " " "
Mr. W. W. Fortheringham	- Canadian Brown Steel Tank Company.
Mr. W. P. Ridsdale	- Link-Belt Limited.
Mr. W. E. Adkins	- Oil Sands Project.

At these meetings Mr. Adkins gave the others present a first hand account of the difficulties which had been encountered together with means of correction which had been suggested by watching the plant in operation. Ore milling practice was also discussed in so far as it was applicable to the problems under discussion. The corrective measures as finally decided upon at these meetings were those subsequently carried out with some very slight modifications.

DISCUSSION OF 1948 OPERATING DIFFICULTIES

Briefly the difficulties discussed and the suggested method of correction were as follows:

1. Trouble had been encountered in the inclined conveyor which elevates the sand into the revolving screen. At various times lumps lodged

in the bottom end of the conveyor and the accumulation of sand which built up around these lumps ultimately overloaded the conveyor and caused the motor to cut out. Discussion revealed that a baffle plate which was to have been installed in the lower end of the conveyor to prevent lumps falling back out of reach of the screw had been left out during fabrication. Link-Belt undertook to supply drawings showing details of the plate and its installation. No further trouble has been encountered at this point.

2. The cast iron bevel gears supplied by Link-Belt on two of the conveyor drives failed several times necessitating shutdowns so they could be repaired. Calculations revealed that cast iron was not strong enough to transmit the torque developed by these particular drives. When this was pointed out to Link-Belt they agreed to supply cast steel gears, free of charge, to replace the original gears.

3. The Water Sealed bearings with which the Link-Belt equipment was equipped gave a great deal of trouble due to seizing. It subsequently developed that Link-Belt had failed to provide sufficient clearance in these bearings and they agreed to stand the expense of the necessary machining to correct this mistake.

4. In operation it was shown that the skimming conveyor in the Separation Cell was incapable of removing the separated oil at a high enough rate. This became a bottleneck in the whole operation and as a result it was only possible to feed the plant at one-third of its designed capacity. The oil as it was skimmed from the Separation Cell was moved up an inclined launder before being discharged into the Wet Oil Settler. There appeared to be no reason why this launder need be so long nor why the rise should be so great and it was decided to reduce these dimensions by approximately 75%, also since suggested modifications to the skimmer seemed unsatisfactory, it was agreed that it should be removed entirely and replaced by rotating paddles such as are used on flotation cells. These could be driven from outside the cell and thus there would be no chains or sprockets subjected to wear by being immersed in dirty oil.

5. Initially the tailings screw refused to elevate sand because there was too much clearance between the screws and the trough making it impossible for the screws to support the semi-fluid tailings. This was rectified in September of 1948, by the installation of a liner which not only reduced the clearance around the screws but separated them by means of a hogback. Since the plant had only been operated at one-third its normal rate, however, some doubt was expressed as to how this conveyor would perform under heavier loads. Mr. Ridsdale advised that this conveyor should handle 840 tons per day which exceeded the maximum requirements. It was further his opinion that the free water discharged with the tailings would not be increased, although the amount of water entrained with the sand would increase in direct proportion to the amount of sand being handled. He also recommended reducing the speed of the conveyor from 18 to 14 r.p.m. This would permit a longer drain back period after the sand left the surface of the water. Link-Belt undertook to prepare a recommendation for a drive to make the necessary speed reduction.

6. It was found during operation that the Froth from the Separation Cell was much cleaner than had been expected and in consequence the load on the Wet Oil Settler was much lighter than calculated. Under these circumstances, the large Settling Tank provided seemed unwarranted especially since the flight conveyor installed in it to remove settlings was prone to frequent mechanical failures. Under normal conditions little, if any, sediment is collected at this point, therefore, it was agreed that a small thickener would handle the job adequately with ample safety factor should poor separation temporarily increase the settling load. The method of removal of underflow from this thickener came in for considerable discussion. The original recycle screw obviously had to be abandoned since it was much too large and Link-Belt was not prepared to recommend a small screw conveyor for this job due to the length

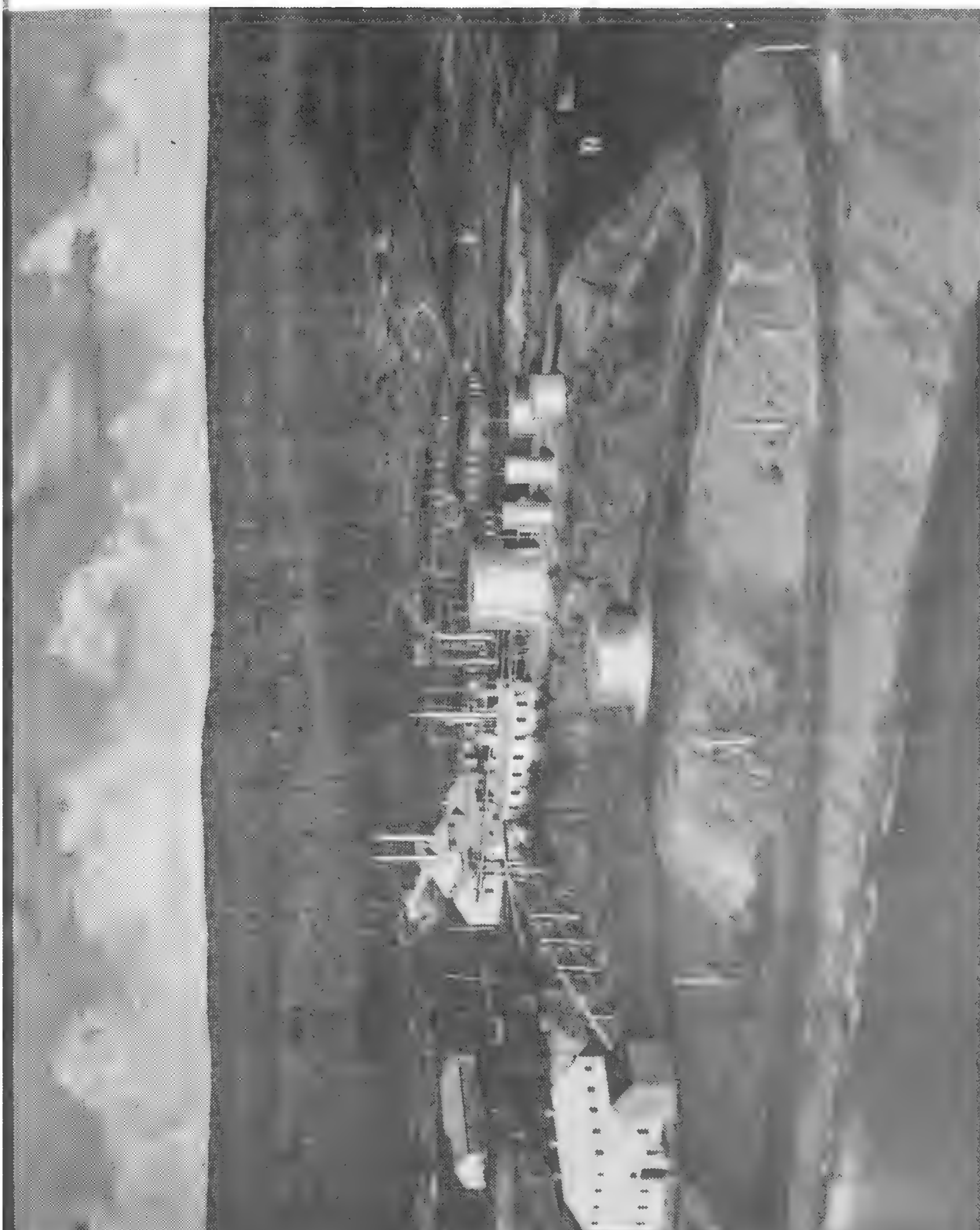
of screw required and difficulty of controlling the amount of oil that would be recycled with the settlings. It became apparent, therefore, that what was required was a pump capable of handling varying amounts of oil containing a heavy concentration of mineral matter.

7. The pumps which had been purchased to pump the wet oil from the Separation Plant to the Dehydration Unit proved very unsatisfactory. These were rotary pumps which depended on a reasonably close mechanical fit to maintain their efficiency and they were entirely incapable of coping with the abrasion resulting from the fine mineral matter entrained in the oil. There were in the plant, however, two rubber lined pumps on other applications and the performance of these pumps led to the conclusion that it would be desirable to obtain rubber lined pumps for pumping oil when it still contained appreciable amounts of mineral matter. It was further felt that if such pumps were obtained they would probably handle the underflow from the Wet Oil Settler mentioned under Item 6 above. In all, 53 pump companies were asked to submit recommendations for the two pumping problems. These recommendations were carefully checked and all but two eliminated. The pumps recommended by the Shriver Pump Company and Robbins & Myers Incorporated both appeared to be capable of handling the job. Accordingly a small pump for the underflow and a larger pump for the Wet Oil were purchased from Robbins & Myers and a pump for Wet Oil from Shriver. Another small Shriver pump was purchased by the Research Council for investigational work. The pumps purchased from Robbins & Myers which are a rubber lined screw type have given very satisfactory service. The Shriver Pump was a diaphragm type and proved unsatisfactory. This is attributed to the fact that the oil has to flow through complicated valve passages to reach the diaphragm chamber and due to its high viscosity, insufficient oil reached the diaphragm chamber to fill the space at the end of each suction stroke. On the other hand a pump of this type is capable of pulling a considerable vacuum and since the oil was fairly warm (160°), some of the water entrained with it flashed and caused vapor lock. This is a point which must be carefully watched in dealing with Wet Oil.

8. During the initial runs it was shown that the sediment which was deposited in the Process Water Settling Tank could not be removed without mechanical assistance. It was decided, therefore, to convert this tank to a conventional thickener and the Born Engineering Company undertook to prepare drawings covering the necessary changes. The underflow from this thickener was to be pumped into the Tailings Receiver and discharged with the Tailings. During the 1949 season this system worked very well.

9. The ratio-flow controller which was to control the addition of diluent to the Wet Crude proved unsatisfactory due to fluctuation in pressure caused by vaporization of the varying water content of the Wet Oil. It was agreed that the dilution could be controlled satisfactorily by a manually set Flo-Control valve, checked by taking gravities on the resulting mixture. This procedure has proven reasonably satisfactory except that frequent sampling is necessary with increased labor. It is felt that the ratio-flow Controller would do a better job and at present work is underway to devise a system of making its use possible.

10. During sub-freezing weather a large proportion of the mine run Oil Sand delivered at the Separation Plant is in the form of large hard lumps. Due to the fact that little mining was done late in 1948, it was not known definitely how serious this condition might become. Some small scale crushing experiments were conducted from which it was established that a roll type crusher could handle the frozen material without difficulty. In September of 1949 this condition began to manifest itself again and it is now regarded as inevitable that some type of crushing equipment will have to be installed. It is proposed, therefore, to conduct a very inclusive investigation of this problem during the winter of 1949 and 50. This program will be discussed in detail later.



AERIAL VIEW OF PLANT AND CAMP

11. The obtainment of an ample supply of process water for the plant is one of serious proportions. Due to shifting of sand in the river bed the original intake sanded up early in 1948. Under existing conditions the construction of an intake which would be satisfactory under all weather conditions is dependent on being able to confine the river to a definite channel at the point where the intake is built. There are several ways in which the river could be confined in this way, such as the erection of revetments, diversion piers, etc. All of these methods, however, involved construction of considerable magnitude and great expense. There was also the possibility that the main channel might again shift to the east side of the river during the spring break-up in 1949. To facilitate this it was decided to bulldoze a trench through the head of the bar immediately upstream from the plant. This was done in March of 1949 but unfortunately the river level was very low during break-up and although some immediate improvement was noticed the situation became worse during 1949 and at the moment of writing the river has dried up entirely immediately in front of the plant. A complete discussion of the present status of this problem will be given later in this report.

Actual work on the projected alterations outlined above got underway on February 11, 1949. The necessary dismantling work was handled by a small crew and work on a large scale did not commence until March 18. Since transportation of heavy equipment from Waterways to the plant presented several obvious difficulties, every effort was made to devise means whereby old equipment and material could be utilized in the construction of new If this had not been done, little progress could have been made before the opening of the water shipping season. As it was, all alterations were completed early in May. Unfortunately the condition of the river was such that it was impossible to install the water pump until May 27 when some improvement in the situation had occurred.

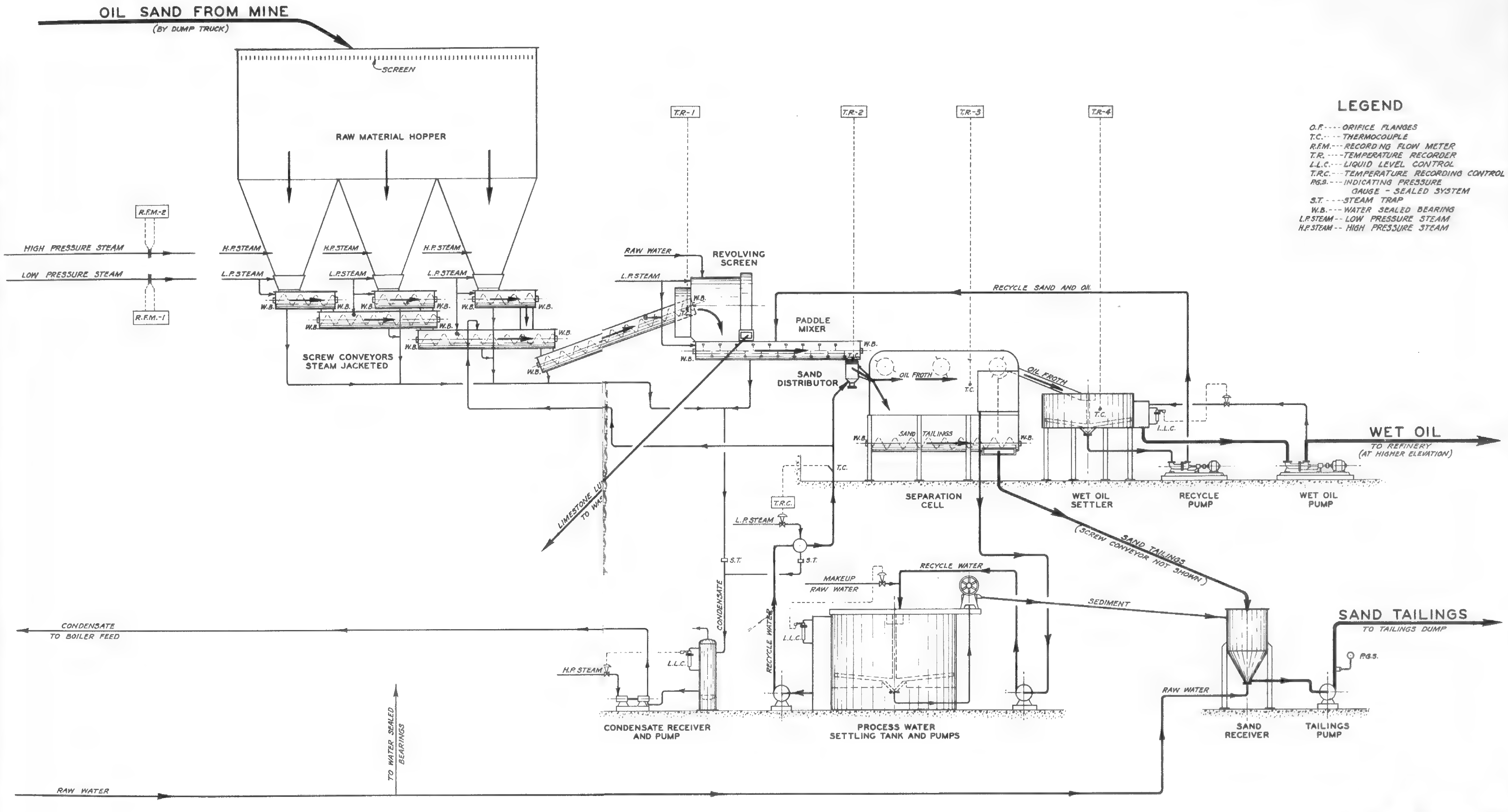
Total cost of alterations and corrective measures taken was approximately $14,000.00, the bulk of which was for labor.

1949 OPERATIONS

The accompanying flow sheets cover the plant as operated during 1949.

Sand is mined at an average rate of slightly over 500 tons per day and delivered to the Separation Plant by dump trucks operating on an 8 minute cycle. The Storage Bin which has a capacity of about 400 tons permits storage of sufficient oil sand during the day shift to keep the plant operating on a 24 hour basis. The injection of high pressure steam into the Feed Hoppers plasticizes the sand sufficiently to cause it to flow into the Feed and Collecting Conveyors which carry the sand into the plant. During feeding hot water is added to the oil sand to raise the overall moisture content to 12% by weight. The action of the screws is to reduce lumps and thoroughly mix the feed. A revolving screen removes limestone which occurs with the Oil Sand as well as foreign objects which are inadvertently included. The Oil Sand passing through the screen is in the form of a heavy pulp, total liquid content being about 25% by weight. In the mixer further reduction of any remaining lumps is effected. The oil film surrounding each grain of sand is or has been broken at this stage and the oil flecks so formed start to coagulate. The agitating action of the mixer tends to aerate these oil particles which is important if the high specific gravity oil is to float in the Separation Cell. Time of retention in the mixer is controlled by means of an adjustable weir at the discharge end but in general approximates 15 minutes. The oil water sand mixture leaving the mixer is mingled in the sand distributor with hot water being recirculated at approximately

MINING OIL SAND IN OPEN PIT OPERATION
NOTE DEPTH OF OVERBURDEN AT THIS POINT



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NO. & DATE	REVISIONS
△ 1-M-5-20-49	REDRAWN

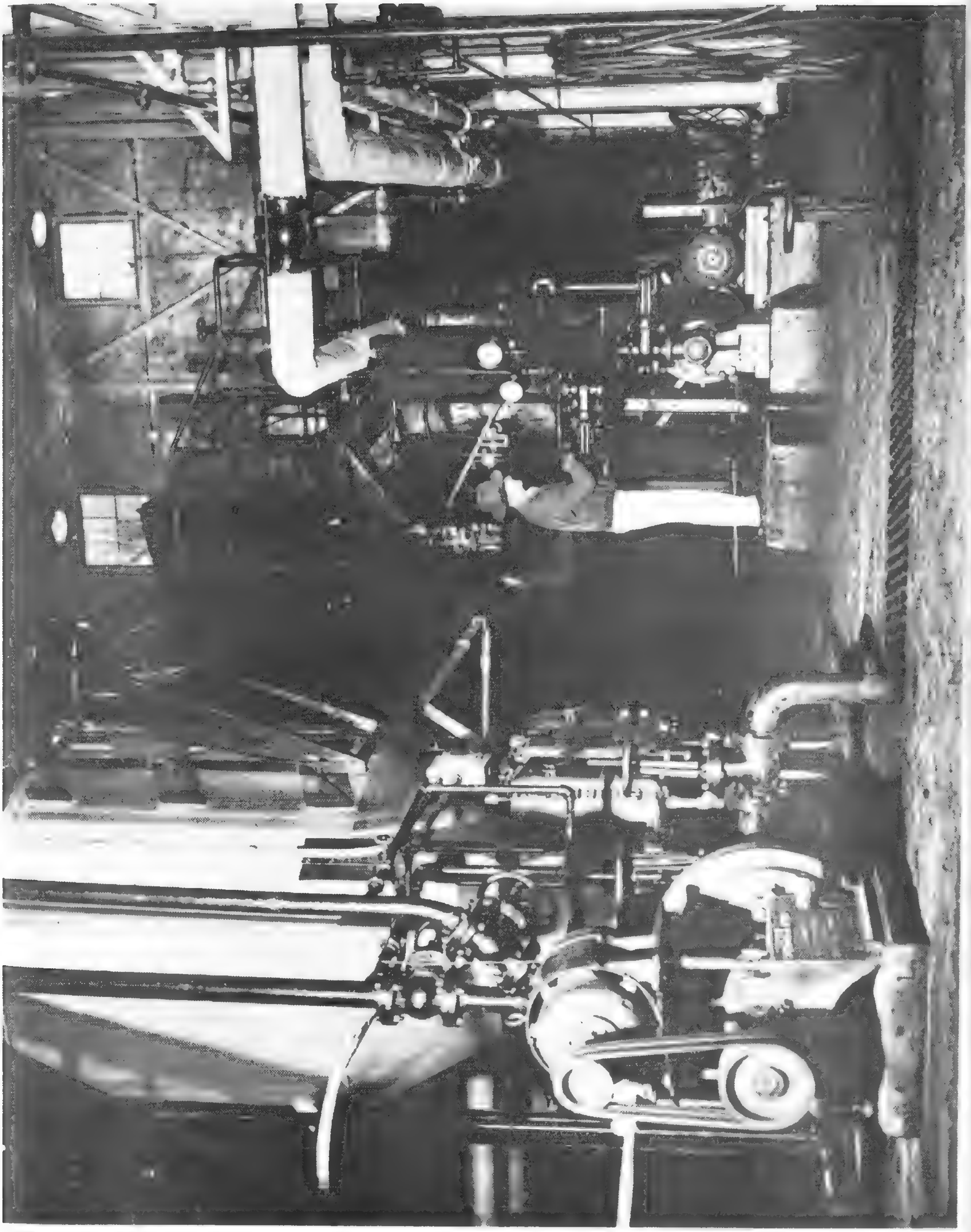
BORN ENGINEERING CO.
TULSA, OKLAHOMA

SEPARATION PLANT
FLOW DIAGRAM

FOR ALBERTA GOVERNMENT OIL SANDS PROJECT

DRAWN	DATE 9-27-49	CHECKED	DWG. 349-00
TRACED	SCALE	APPROVED	

L. L. RIDGWAY CO.



INTERIOR OF SEPARATION PLANT - SAND
RECEIVER AND TAILINGS PUMP AT LEFT

400 G.P.M. Violent agitation results which ensures the entry of the Oil Sand to the Separation Cell as individual grains thus preventing oil inclusions. Further aeration also takes place so that the oil enters the cell as a buoyant froth which floats readily. Under the relatively quiescent conditions existing in the Separation Cell all but the finest mineral matter settles rapidly and is carried to the discharge end by means of a ribbon conveyor. The sand tailings are removed from the Cell by a twin screw dewatering conveyor which elevates the sand to a point above the liquid level in the Cell before discharging into the Tailings Receiver.

The oil-water interface in the cell is maintained slightly below the reach of three sets of rotating paddles which carry the oil froth forward and out of the cell over a curved weir.

It has been established that high percentages of clay in the Oil Sand feed have a detrimental effect on Separation both from the point of view of yields and quality of product. This effect can be minimized by preventing concentrations of suspended solids in the water of the Separation Cell and this is done by continuously withdrawing water from the Cell and settling it in a conventional thickener. The clean overflow from the thickener is reheated by low pressure steam in tubular exchangers and pumped back into the circuit at the Sand Distributor. The underflow containing the clay settlings is pumped into the Tailings Receiver and discharged with the Tailings.

There are three main sources of water loss from the Separation Circuit as follows:

1. Water entrained with the Separated Oil.
2. Water wetting tailings discharged from the Separation Cell.
3. Underflow from the Process Water Settler.

The addition of make-up water is controlled by a Liquid Level Controller or the overflow box of the Process Water Settler where any shortage of water in the circuit is first manifested. Actual addition is through the feed well to the Process Water Settler.

Due to the lack of data on the flow characteristics of pulps, the sizing of the Tailings suction and discharge lines was accomplished by trial and error. It has now been established that tailings can be pumped for considerable distances at concentrations of 40% to 50% solids providing velocities of 8 to 9 feet per second are maintained. Velocities as low as 2.5 feet per second are allowable for short runs not exceeding 8 to 10 feet. After the lines have been correctly sized with regard to the plant throughput, operating practice is to add sufficient water on the suction side of the sand pump to prevent fluctuations in discharge pressure as indicated by a volumetric type pressure gauge.

Under normal operating conditions the oil leaving the Separation Cell contains 25% to 30% water and 4 to 8% mineral matter. The mineral matter is very fine, some of it being of almost colloidal proportions, and will not settle in the heavy oil-water-mixture with which it is associated. In such circumstances the load on the Wet Oil Settler is very light and the amount of settlings may be so small that recycling is unnecessary except at infrequent intervals. Occassionally due to fluctuations in operating conditions, appreciable amounts of coarser mineral matter which will settle to some extent is carried over and in these cases the wet oil settler performs a useful function in returning this carry over.

To affect the removal of the entrained sand and mineral matter the Wet Crude is first diluted with a 30° A.P.I. petroleum distillate and settled in a Denver Thickener. Initially it was felt that to achieve satisfactory settling diluent should be added in the ratio of 50 parts diluent to 100 parts crude (dry basis). Subsequent experience showed that dilution ratios as low as 30 to 100 gave equally

good mineral matter deposition and that gravity settling of water was realised to be erratic and not related to the dilution ratio. The overflow from the Settler still contains an average of 20% water and this is removed by heating in a conventional tube still and flashing. The underflow from the thickener is wasted in the present set up and since it contains appreciable amounts of oil the gross losses at this point are heavy, being in the order of 10% to 15% of the theoretically possible oil recovery. Secondary recovery methods have been studied by which a lot of this oil can be regained but they introduce additional equipment and would probably still encounter difficulty with the very stable emulsions which defeat the present settling system.

As will be seen from the flow sheet the flash vaporization of the water in the crude is a relatively simple operation. The Wet Diluted Crude after heat exchange against water vapor and Dry Crude is heated to approximately 400° F. under pressure and flashed in an 18 foot flash tower. Dry Diluted Crude is drawn off as a bottom product and water vapor and some distillate is removed overhead. The distillate is later recombined with the Dry Crude. Sufficient sensible heat must be added to flash the bulk of the water if foaming is to be avoided. When this happens the Flash Bottoms pump loses suction and heavy oil is likely to get over into the condensers and cause plugging.

Since it was not intended that the Project should support itself in whole or in part by revenue from the sale of products, the refinery is relatively simple and has been designed primarily to fulfill three functions.

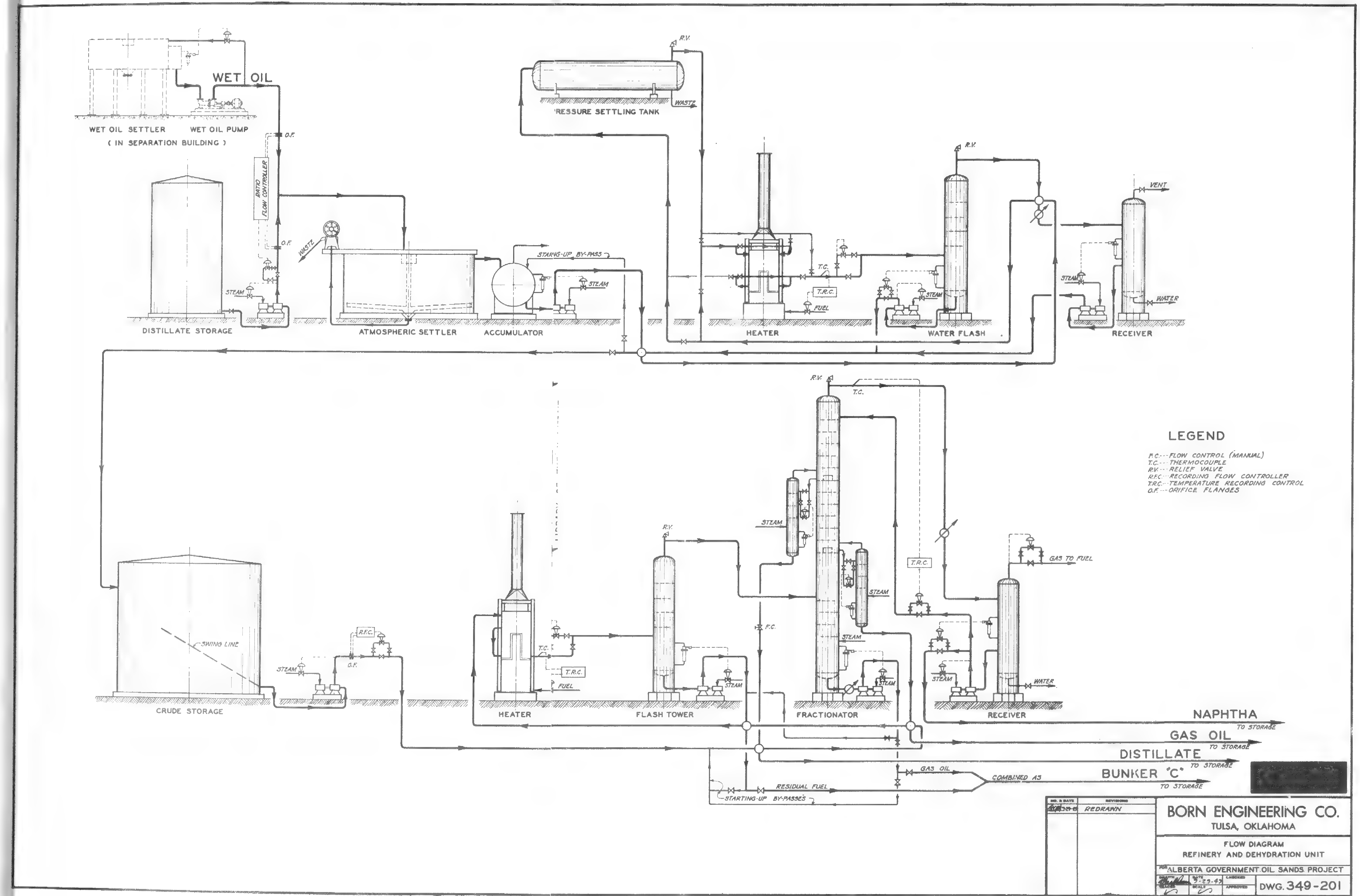
1. Production of fuel oil for use in the Power House, Refinery heater and Dehydration Heater
2. Recovery of diluent added to facilitate "cleaning-up" the Separated Oil.
3. Production of new diluent to balance processing losses.

This is being accomplished by means of a mild Vis-breaking operation The diluted crude charge is raised to approximately 500° F. by heat exchange with all products except the naphtha. The heater outlet is carried at 825 F. and 50 PSIG back pressure. A Flash Tower has been included in the circuit to prevent carry over of solids and coke into the fractionator Products are naphtha, distillate, light gas oil, heavy gas oil and residuum The heavy gas oil is combined with the residuum and the blend used as fuel oil. The three top cuts are being combined as diluent at present but this will be discontinued when an adequate supply of diluent has been accumulated.

Only four operating problems of a major nature developed during the 1949 operations and these were successfully overcome. It was found that the wire mesh covering the Rotary Screen was much too light and also that the mesh was too large which allowed stones up to 2" in diameter to pass into the Separation equipment. Occassionally these stones carried through to the Tailings Pump without appreciable reduction in size and lodged between the impeller and the casing. Replacement of the original screen with a manganese-steel screen of 1¼" mesh almost completely eliminated this difficulty. It is almost impossible to prevent small sticks and roots from getting into the Oil Sand feed. The roots especially being tough and fibrous caused the greatest difficulty lodging in pumps, under valve seats, etc. A screen with ½" openings was installed across the launder between the Separation Cell and the Wet Oil Settler. It was so designed that it could be removed periodically for cleaning and satisfactorily eliminated all objects light enough to float in the oil froth.

At the commencement of 1949 operations the Tailings Pump was equipped with a 6" suction and a 3" discharge. With this arrangement a large amount of water had to be added at the pump suction to keep velocities high enough to prevent settling of the sand and plugging of

PART OF REFINERY AND DEHYDRATION UNIT


WET OIL
WET OIL SETTLER
WET OIL PUMP
(IN SEPARATION BUILDING)
O.F.
RATIO FLOW CONTROLLER
WASTE
STEAM
DISTILLATE STORAGE
ATMOSPHERIC SETTLER
ACCUMULATOR
STARTING-UP BY-PASS
R.V.
PRESSURE SETTLING TANK
WASTE
T.C.
T.R.C.
FUEL
HEATER
WATER FLASH
VENT
WATER
RECEIVER
LEGEND
F.C.---FLOW CONTROL (MANUAL)
T.C.---THERMOCOUPLE
R.V.---RELIEF VALVE
R.F.C.---RECORDING FLOW CONTROLLER
T.R.C.---TEMPERATURE RECORDING CONTROL
O.F.---ORIFICE FLANGES
SWING LINE
R.F.C.
CRUDE STORAGE
HEATER
FLASH TOWER
FRACTIONATOR
F.C.
GAS TO FUEL
RECEIVER
NAPHTHA TO STORAGE
GAS OIL TO STORAGE
DISTILLATE TO STORAGE
BUNKER "C" TO STORAGE
GAS OIL
COMBINED AS
RESIDUAL FUEL
STARTING-UP BY-PASSES
NO. & DATE
REVISIONS
REDRAWN
BORN ENGINEERING CO.
TULSA, OKLAHOMA
FLOW DIAGRAM
REFINERY AND DEHYDRATION UNIT
FOR ALBERTA GOVERNMENT OIL SANDS PROJECT
CHECKED
APPROVED
SCALE
DWG. 349-201

the lines. Since water was at a premium, any unusual demands in other parts of the plant dropped the supply pressure hence the quantity available and usually ended in a shutdown. Trial and error eventually established the suction size at 4" and the discharge at 2½". With these sizes the pump will handle 500 tons of sand per day at 40% solids. The velocity in the discharge line is low enough to prevent serious erosion and at the same time the velocity in the suction line is high enough to keep the pump flooded. Subsequently a Volumetric Pressure Gauge was installed on the discharge of the pump. Fluctuations in pressure at this point immediately indicate that the pump is running dry and the operator can rectify the deficit before trouble develops.

During the first refinery runs difficulty was experienced in recovering sufficient light ends to balance the operation. Previous experimental data was to the effect that oil sand crude decomposed rapidly at relatively low temperatures with pronounced coke formation. In consequence it was decided to maintain the heater outlet at 750° F. Since this proved inadequate, the outlet temperature was gradually raised to 825° F. This gave adequate yields of light ends and no coke formation was noted. It seems likely that opinions regarding the cracking characteristics of oil sand crude had been based on batch operations and that the low temperatures required were regarded as noteworthy whereas the time element had been completely neglected.

One of the greatest problems with which those responsible for the project have to contend is the obtainment of adequate operating personnel Due to the remote location getting men of any kind is difficult and finding trained men is practically impossible. In consequence much valuable time is lost at the beginning of each season's operations while new men are trained. During this training period personal error is high and as a result small operating difficulties which could be rectified easily by experienced operators usually develop into major troubles. This year has been no exception in this regard To illustrate the improvement in operating efficiency as the operators become more proficient, we present the following tabulation of runs made in the Separation Plant.

RUN NO.	DATES OF RUN	TOTAL HOURS	HOURS ON STREAM	OPERATING EFFICIENCY
1.	May 30	13.5	10	74%
	May 31	making repairs in Separation Plant.		
2.	June 1 - 4	79	$71\frac{3}{4}$	91%
	June 4 - 15	making repairs and changes to Separation Plant and Dehydration Unit Refining June 13 - 14.		
3.	June 16 - 19	79	71	89.5%
	June 19 - July 3	making repairs and changes to Separation Plant and extending tailings dump - Refining June 24 - 25 - 26		
4	July 4 - July 13	214.5	124.25	58%
	July 13 - 17	making repairs and changes to Separation Plant. Refining July 16 - 17		
5.	July 18 - 23	131	88	69.2%
	July 24- Aug. 11	making repairs to Separation Plant. Explosion occurred while welding in Separation Plant July 29. Repairs completed by August 11. Refining July 26 - 27 - 28 - 29.		
6.	Aug. 12 - 21	200	97	48.5%
	Aug 22 - 23	Refining - no repairs to Separation Plant necessary.		
7.	Aug. 24 - 27	55	51	93.0
	Aug. 28 - 31	Refining - no repairs to Separation Plant necessary.		
8.	Sept 1 - 7	123	121.5	99.0%
	Sept. 8 - 11	Refining - no repairs to Separation Plant necessary.		
9.	Sept 12 - 20	199.5	196.5	98.6%
	Sept. 21 - 28	Refining - no repairs or alterations to Separation Plant.		
	Sept 29	Operations suspended for 1949.		
	Total for 1949 Season	1094.5	831	76%

In the foregoing tabulation Total Hours represents the duration of the particular run. Hours on stream is the period during which the Separation Plant was actually producing oil. Operating efficiency is on stream hours expressed as a percentage of Total Hours.

Runs 1, 2, and 3 are not regarded as significant as operation was only maintained with great difficulty and at reduced capacity. Time losses during runs 4, 5, and 6 were made up of numerous interruptions of varying duration.

The final limiting factor on the length of all runs was the amount of diluent available. Since lack of operating personnel necessitated the operation of the Separation Plant and Refinery alternately, it was always necessary to shut down the Separation Plant when stocks of diluent were expended. With an adequate complement of operators both units could be operated simultaneously until such time as mechanical failures made a shutdown necessary. Runs 7, 8, and 9 were concluded due to lack of diluent.

It would be entirely beyond the scope of this report to include complete operating data for each of the nine runs made in the Separation Plant and Refinery. However, since it is felt that some indication of plant operating conditions would be of interest, we present herewith salient figures for one typical shift in each of the Plant Units.

1. SEPARATION AND DEHYDRATION UNITS

Oil Sand Feed Rate	- 500 Tons per 24 hours
Water in Feed (After adjustment)	- 11.3% by weight.
Steam Consumption for heating	- 2200 #/HR. @ 8 P.S.I.

Temperatures °F.

Screen Inlet	- 110
Mixer Outlet	- 135
Recycle Water	- 200 (at heater outlet)
Separation Cell	- 185
Wet Oil Settler	- 130
Diluted Crude Settler	- 162
Flash Tower	- 350
Dehydration Heater Outlet	- 415
Water Receiver	- 100

Pressures P.S.I.

Tailings Discharge	- 22
Recycle Water	- 21.5
Raw Water	- 62
Dehydration Heater Inlet	- 45
Dehydration Heater Outlet	- 20
Flash Tower	- 18
Pressure Settler	- 25

Inspections

Oil Sand Feed (after adjusting water content)

% water	- 11.3
% oil	- 11.0
% mineral matter	- 77.7
% oil (dry basis)	- 12.4

Separated Crude

% water	- 25.0
% oil	- 68.0
% mineral matter	- 7.0

Wet Diluted Crude (after settling)

% water	- 19.3
% oil	- 78.2
% mineral matter	- 2.48

Dry Diluted Crude (to storage)

% water	- 0.24
% oil	- 97.96
% mineral matter	- 1.80

Underflow Diluted Crude Settler

% water	- 38.3
% oil	- 13.5
% mineral matter	- 28.2

Contains extra water added to increase fluidity. Actual underflow is of the order of 18% water, 26% oil, 56% mineral matter.

Tailings

% oil	- 1.13

Underflow Process Water Settler

% Solids	- 18.3

Overflow Process Water Settler

% Solids	- 0.22

Crude Recovery expressed as % of Theoretical Oil	- 80.5
Diluent Loss expressed as % of Theoretical Oil	- 1.2
Net Oil Production expressed as % of Theoretical Oil	- 77.1

2. **REFINERY**

Charge Rate - 420 Barrels per day

Temperatures $^{\circ}F$

Heater Inlet	- 500
Heater Outlet	- 825
Flash Tower	- 700
Fractionator Top	- 390
Fractionator Bottom	- 590
Naphtha Receiver	- 100

Pressures P.S.I.

Heater Inlet	- 85
Heater Outlet	- 50
Flash Tower	- 12
Fractionator	- 11
Naphtha Receiver	- 8

Yields Volume % of Charge

Original Diluent	- 24%
New Diluent	- 6%
Blended Fuel Oil	- 69%
Gas and Loss	- 1%

Inspections

Charge Stock (Diluted Crude)

Gravity °A.P.I.	- 11.7
B.S. & W.	- 1.97
Viscosity S.S.F. @ 122 °F	- 100

Naphtha

Gravity °A.P.I.	- 44.5
A.S.T.M. Distillation °F	
I.B.P.	- 130
10 percent	- 278
50 percent	- 346
85 percent	- 400
90 percent	- 414
E.P.	- 457
Octane Number Clear (Motor Method)	- 66.8
Sulphur percent	- 1.3

Diluent

Gravity °A.P.I.	- 30.0
A.S.T.M. Distillation °F.	
I.B.P.	- 270
10 percent	- 404
50 percent	- 502
90 percent	- 663
E.P.	- 720

Blended Fuel Oil

Gravity °A.P.I.	- 6.2
Viscosity S.S.F. @ 210 °F.	- 62.5

SUMMARY OF PLANT PRODUCTION 1949.

MINING

Time Mining Equipment Operated	265.25 hrs.
Sand Mined	14866.5 Tons

SEPARATION PLANT & DEHYDRATION UNIT

Diluted Crude Produced	408,600 Gals.
Actual Crude Oil Produced	274,624 Gals.

REFINERY

Diluted Crude Charged	399,945 Gals.
Fuel Oil Produced	255,279 Gals.
Diluent Produced (Including Recycle)	139,432 Gals.

RECOVERIES

Using the Hot Water Separation Process as presently employed at Bitumount, it appears that ultimate oil recovery will lie between 75% and 80% of the theoretical oil present in the Oil Sand charge.

Analyses of the Tailings from the Separation Plant show that approximately 10% of the original oil is lost at this point. The bulk of this loss is due to failure of part of the oil to float and this fraction is picked up in the plant water and deposited in the Process Water Settler from whence it is pumped into the Tailings Receiver. Since the total volume of underflow from the Water Settler is low, a secondary recovery operation on this material would be practical and relatively inexpensive.

The balance of the losses take place after dilution and during settling and vary from 10% to 15% of the theoretically possible recovery. The bulk of this loss is of course in the underflow from the Atmospheric Settler although further losses as emulsion occur in the Crude Accumulator and the Pressure Settler. Heat, Pressure and usual chemical emulsion breakers are not effective in reducing these dispersions. In consequence the present "cleaning-up" operation as practiced at Bitumount is regarded as highly unsatisfactory, both because of the attendant oil losses and the fact that the overflow from the Settler still contains an average of 20% water which must be removed by flash-vaporization involving considerable fuel expenditure. Work done by the Research Council indicates that some of the loss could be recovered by working over the underflow from the Settler. This has the disadvantage of requiring additional equipment with increased labor and it would still not reduce the water content of the settled oil, also it would probably encounter difficulty with emulsions. It is felt that a more direct approach is required. A method by which the emulsions could be broken immediately after dilution and which would, if possible, eliminate the present Settling and Dehydrating procedure would materially improve the economics of the whole operation.

The fact that electrical precipitation is effective in dehydrating the heavy crudes produced in the Vermillion and Lloydminster fields suggests that the same equipment with or without modification might be effective on the diluted crude produced at Bitumount as the gravities

WET CRUDE ACCUMULATOR AND ATMOSPHERIC SETTLER

are much the same. This possibility is being further explored and work is being carried on at present in co-operation with the Petrolite Corporation, Licensors of the process.

PERSONNEL REQUIREMENTS

The following personnel are required for operation of the whole plant on a 24 hour basis, 7 days per week.

GENERAL:-	
Superintendent	1
Supervisor of Operations	1
Supervisor of Maintenance	1
Accountant	1
Clerk & Stenographer	1
Warehouseman	1
Chemist	1
Laboratory Assistants	3
Pipefitters	1
Welders	1
Machinist	1
Mechanic	1
Laborers	3
Tractor Operator	1
MINING:	
Shovel Operator	1
Truck Drivers	2
Greaser	1
SEPARATION PLANT:	
Operators	3
Operators Helpers	3
Swing Operator	1
REFINERY & DEHYDRATION UNIT:	
Operators	3
Operators Helpers	3
Swing Operator	1
POWER HOUSE:	
Chief Engineers	1
Shift Engineers	3
TRANSPORTATION:	
Boat Crew	2
Agent at Railhead	1
CAMP OPERATION:	
Cook	1
Kitchen Helpers	3
Caretaker	1
TOTAL PERSONNEL:	48

EQUIPMENT REQUIREMENTS

The present plant is capable of processing 500 tons of Oil Sand per day. All units appear to be well balanced and no bottlenecks developed during the past season's operations. With Oil Sand averaging 12% oil by weight, yields will approximate 275 barrels per day when charging 500 tons of Oil Sand. With higher grade Oil Sand yields will be directly proportional to oil content.

To carry on this scale the following equipment has been found necessary. Values given are for each of the items delivered or erected at the plant site. Each unit bears its appropriate share of overhead charges.

Mining Equipment -	25,747.00
Separation Plant -	203,160.00
Dehydration Unit -	52,945.00
Refinery -	65,455.00
Powerhouse -	111,400.00
Tank Farm & Yard Lines -	38,638.00
Utility Lines -	31,193.00
Water Supply System -	28,618.00
Office & Laboratory -	14,052.00
Machine Shop & Warehouse -	17,053.00
Garages -	8,115.00
Plant Tools & Equipment -	48,777.00
Camp & Equipment -	59,764.00
Transportation Equipment -	10,729.00
Dock -	2,298.00
Airport -	3,461.00

The following Depreciation Rates are suggested as being applicable to the present operation.

Storage Tank -	)
Stock Tanks -	) Av. 5%
Oil Lines & Steam Lines -	7%
Sewers -	10%
Shop & Machine Tools -	10%
Hand Tools -	20%
Buildings & Structures -	5%
Pumps & Compressors -	10%
Boilers -	8%
Refinery Equipment -	10%
Tubular Condensors -	20%
Tubular Exchangers -	10%
Separation Equipment - (other than above)	15%
Laboratory Equipment -	25%
Trucks -	25%
Tractors with dozers -	25%
Shovels -	20%
Welding Equipment -	15%
Compressors Gasoline Driven -	15%
Boats -	12½%
Wooden Barges -	10%

FUEL CONSUMPTION

While it is recognized that substantial Fuel economies could be realized by operating the Separation Plant and Refinery simultaneously, no figures are available as to these savings and no attempt will be made to estimate their magnitude. The following figures are average consumption rates when operating the two units independently. In both cases

the turbo-generator was being used and all power and heat requirements were derived from this source both for plant and camp.

1. Operating Separation Plant Only.

Total Fuel Consumption	Power House	Dehydration - Heater
2350 Gals/24 Hrs.	1800	550

2. Operating Refinery Only.

Total Fuel Consumption	Power House	Refinery Heater
1934 Gals/24 Hrs.	1100	834

Effect of Abrasion on Plant and Equipment.

Although total experience in this field has not been extensive enough to determine the life of all classes of equipment, certain points have been established as being subjected to excessive wear.

With the exception of Shovel Teeth the mining equipment does not appear to be subjected to more arduous conditions than would be encountered in normal earth moving. Practice is to build up worn shovel teeth by electric welding and experience with two typical types of rod is given below.

Rod A.

This electrode has good abrasive qualities but is brittle and tends to chip in hard digging.

Rod B.

This electrode will not stand severe abrasion but will stand considerable impact.

Rebuilding Set of 4 Teeth with Rod A.

Cost per pound	\$ 1.62
Electrode used	6 #
Electrode cost	\$ 9.72
Labor cost	\$11.60
Total cost	\$21.32
Life of Tooth	32 hrs.
Maintenance cost per hour	\$ 0.66½

Rebuilding Set of 4 Teeth with Rod B.

Cost per pound	\$ 0.49
Electrode used	8 #
Electrode cost	\$ 3.92
Labor cost	\$ 8.70
Total cost	\$12.62
Life of Tooth	8 hrs.
Maintenance cost per hour	\$ 1.58

After the suspension of operations a thorough inspection of the Plant equipment was made in an effort to determine where, if any, wear had occurred. The following are the observations and conclusions.

1. Conveyor flights and troughs - no appreciable signs of wear - estimated life indefinite.

2. Water sealed bearings on conveyors, etc. - .004" to .006" increase on I.D. of most journals but still serviceable - estimated life 1800 hours.

3. Liner and Rotor of Wet Oil Pump - some signs of wear but still serviceable - drop in maximum output pressure 75 P.S.I. - estimated life 1800 hours minimum.

4. Tailings pump - considerable wear on suction side of liner - estimated life 700 hours - other half of liner should last indefinitely - Some wear on impeller - estimated life 3000 hours.

5. Water circulating pumps - Impellers slightly pitted but not excessively - impeller shaft sleeves required replacement - probable life 200 hours.

6. Diaphragm Pump on Process Water Settler - diaphragm O.K. - estimated life 1500 hours - valve seats required replacement - probable life 800 hours.

7. Piping - no serious signs of wear - can make no sensible estimate of probable life at this time.

8. Diaghragm Pump - on Atmospheric Settler - Diaphragms and Valve Seats require replacement approximately every 600 hours.

9. Wet Crude Charge Pump - requires new liners, plungers and rings in liquid end after 850 hours.

10. Flash Bottoms Pump on Dehydration Unit required new liners, plungers and rings in liquid end after 700 hours.

11. Refinery Charge Pump - requires new liners, plungers, and rings after running 400,000 Imperial Gallons.

12. Refinery Flash Bottoms Pump - same as above.

The four pumps mentioned above are reciprocating pumps and it would appear that the diluted crude contains too much suspended mineral matter to permit the economic use of such equipment. The choice of suitable substitutes poses a considerable problem due to the variation in operating pressures required and the high temperatures encountered on these applications. This problem is encountered wherever crude or bottom products are being handled.

13. Piping Refinery and Dehydration Units - no appreciable signs of wear.

14. Heaters - no appreciable signs of erosion in tubes or headers of either heater.

15. Vessels - no signs of erosion even opposite vapor inlet on Flash Towers.

Reasons for Suspension of Operations - 1949.

While the only pressing reasons for suspending operations in 1949 were lack of operating personnel and failure of the plant water supply, there are other imminent difficulties which will have to be dealt with if operations are to be resumed at Bitumount and continued for any length of time. It is proposed to cover all of these problems in detail and where possible suggest some corrective measures.

1. Lack of Operating Personnel.

The task of obtaining sufficient men to carry on the work at Bitumount has been one of considerable magnitude ever since the inception of the Project. It must be appreciated that although the plant is only 55 miles from Fort McMurray and Waterways, lack of usual methods of transportation makes it unfeasible for men to visit these towns except at very unfrequent intervals. Due to the relatively small number of people employed it is economically impractical to provide recreational facilities except on a very limited scale. These features, coupled with the fact that no family accommodation is available, soon manifests itself in excessive boredom and declining morale. While labor turnover was excessive during construction, replacements were usually fairly readily available as construction workers are traditionally of an itinerant nature. Since high labor turnover amongst trained operating personnel is more costly and causes delays, ways and means of obtaining and holding such men were considered. Early in 1949 it was recommended to the Board of Trustees that permission be granted to pay an isolation bonus to everyone employed at Bitumount. To qualify for the bonus an employee had to spend one year on the Project or if cessation of operations prevented this, he would receive whatever portion of his bonus he had earned up to that time This recommendation was accepted and a bonus equal to 10% of each employees regular earnings while at Bitumount has been paid this year. While this added inducement did stabilize the personnel at the plant, it was not sufficient to attract trained operators or enough men capable of being trained as operators. As a result it was never possible to operate all the plant units simultaneously.

The fact that the Project has failed to provide continuous employment in the past will make it increasingly difficult to hire suitable men for each seasons' operations. If operations are to be resumed on a seasonal basis it is recommended that the possibility of borrowing men from some of the oil companies be investigated or failing in this, that the oil companies be approached with a view to providing employment for men when they are released from the Project. In this way reasonable continuity of employment could be promised. If operations of considerable duration are contemplated, it is recommended that family dwelling be provided for at least the key members of the operating crew.

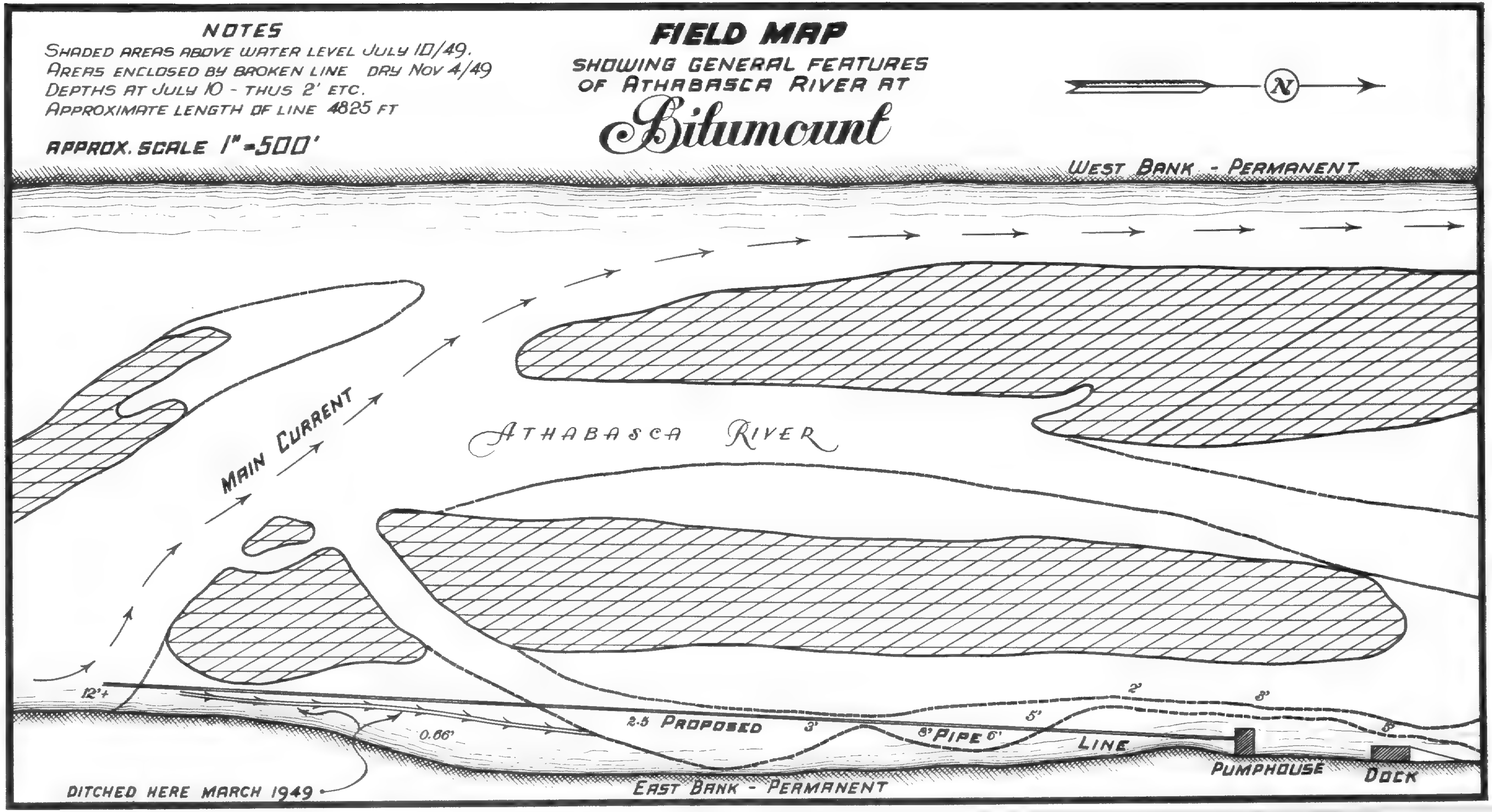
2. Water Supply

As has been mentioned previously the condition of the east channel of the Athabasca River deteriorated still further in 1949. The composite photograph taken on November 4 shows that the river is now completely dry in front of the plant making the procurement of water at this point impossible. A rough survey of the east channel of the river was made on July 10 when the water level was about average for the 1949 summer season. The situation existing in the area south from the plant to the head of the bar which is blocking the channel is illustrated on the included field map. Under existing conditions it would appear that the only practical source of water is at the head of the bar. Since the whole bar is moving slowly downstream, there is little likelihood of an intake plugging if located at this spot. Obtaining water downstream from the plant is not regarded as practical due to local pollution from sewage and seepage from the Tailings Dump.

In order to obtain water from the point suggested, approximately 4825' of at least 8" line would be required. This line could be laid in the east channel as indicated on the field map and graded so that it would flood the suction of a pump located below the Separation Plant. This would have the advantage of keeping the pump where it could be serviced without difficulty and by the regular plant operators.

This solution was suggested to the Board of Trustees last summer but was deferred at that time because of the cost which is estimated at $50,000.00. If further operations are contemplated, however, water will of course be necessary and this proposal should be given further consideration.

COMPOSITE PHOTOGRAPH
SHOWING CONDITION OF RIVER
CHANNEL AT BITUMOUNT
NOVEMBER 4, 1949


NOTES
SHADED AREAS ABOVE WATER LEVEL JULY 10/49.
AREAS ENCLOSED BY BROKEN LINE DRY NOV 4/49
DEPTHS AT JULY 10 - THUS 2' ETC.
APPROXIMATE LENGTH OF LINE 4825 FT
APPROX. SCALE 1" = 500'
FIELD MAP
SHOWING GENERAL FEATURES
OF ATHABASCA RIVER AT
Bitumount
N
WEST BANK - PERMANENT
MAIN CURRENT
ATHABASCA RIVER
12'+
0.66'
2.5 PROPOSED
3'
8" PIPE 6'
5'
2'
LINE
8'
8'
PUMPHOUSE
DOCK
DITCHED HERE MARCH 1949
EAST BANK - PERMANENT

3. Storage.

At the present time there is available at the plant total storage capacity of approximately 11,150 barrels distributed as follows.

Product	Barrels	Gallons
Crude	5000	175,000
Diluent	1900	66,500
Fuel Oil	4250	148,750

This is adequate for a relatively short period of operation using the present system of refining which yields small amounts of light ends and large amounts of residual products or fuel oil, but since there is no outlet for products of this type except internal consumption, storage would rapidly become a problem.

Comparison of Product Inventories
Quantities in Imperial Gallons

	Purchased to start operations 1948	On Hand at Close 1948 Operations	On Hand at Close 1949 Operations
Fuel Oil	33,115	11,831	105,144
Diluent	34,975	27,429	33,078
Diluted Crude		6,110	8,855

From the foregoing it can be seen that despite very intermittent operation in 1949 and even though the powerhouse was operated for extended periods when the plant was not in production, inventories increased substantially relative to available storage capacity.

When operations were suspended in September, 1949 Fuel Oil inventories were increasing at approximately 17,000 gallons per week and diluent inventories at approximately 3,000 gallons per week. If both Separation Plant and Refinery were operated simultaneously, inventories would increase by 45,000 gallons and 6,000 gallons for Fuel Oil and Diluent respectively. Since the Fuel Oil does not meet usual specifications and would be heavy and difficult to transport, there would seem to be little justification for erecting tankage to store it. The only alternative, therefore, is to dump it in earthen pits realizing that it could never be profitably recovered. Due to the fact that it would represent a potential fire hazard, Diluent could not be disposed of in this fashion. It could be burnt or perhaps by some relatively inexpensive treating process a portion of it could be rendered saleable as Diesel Fuel.

By utilizing some combination of the above expedients, operations could be carried on for some time following the same procedures as employed this year.

It might be argued, however, that since the Project is being financed by Public Funds production should not be wasted if some means of converting it to saleable products is available, and which would at least partially defray the cost of operation. The simplest method of accomplishing this would be to install a coking unit which could reduce all the Residuals to coke and relatively light petroleum fractions. The coke could then be used for boiler fuel and the light products disposed of. A continuous delayed coking unit of sufficient capacity would

probably cost a minimum of $150,000.00 and in addition sufficient storage would have to be provided to store liquid products when the river is closed to navigation. Recent developments in a new coking process known as the "Continuous Contact Coking Process" show great promise and if it could be used much of the present refinery could be incorporated thus effecting a considerable saving. Progress on this method is being followed closely and full information should be available when and if further consideration becomes necessary. Samples of Oil Sands crude have already been submitted to the Lummus Company owners of the Process. They have done considerable preliminary investigational work on it and are satisfied that it would be suitable Charge Stock for their process.

4. Tailings Disposal

During all operations to date tailings have been deposited in a ravine on the north side of the Separation Plant. The disposal area available here has been extended by digging a large trench north to the old open pit mine operated by Oil Sands Limited. In spite of the added capacity, however, it is estimated that a total of only 30 days operation would completely exhaust this space and make necessary other arrangements.

One possible solution is to elevate the tailings sufficiently at the Separation Plant to permit fluming them on to level ground north and east of the plant where they would be retained by earthen dykes. To do this would require a second Sand Pump operating in series with the present one as the pump now in use hasn't sufficient head. Higher head pumps are available but they are close clearance pumps and would probably experience difficulty with the small pieces of limestone associated with the tailings. Approximately 1000' of elevated flume would be required, the line being constructed of vitrified sewer tile or cast concrete pipe. The installation of such a line would give experience in handling tailings over long distances which would be necessary in a large scale operation.

Another alternative would be to use the present tailings dump and to remove sand from it periodically by Carryall-Scraper or similar means.

In view of the fact that the river has swung almost entirely to the west side of the channel it might be permissable to use the river bottom immediately in front of the plant. This would have to be checked and approved by the Department of Transport but if available, would offer a simple and inexpensive solution.

It has also been suggested that the tailings be backfilled into the mine. This would not be feasible at the present stage of mine development nor for some time to come.

5. Transportation

Lack of water near the plant makes it impossible to dock boats or barges there for much of the year. While this is now a minor difficulty since little heavy equipment is brought in, some sort of docking facilities are necessary. Choice of a suitable location involves finding a spot where the water is deep, the banks stable and to which access roads can be built without too much difficulty. To date no such combination has been located in the vicinity of the plant.

PRESENT STATUS OF THE PROJECT

Operations at the Demonstration Plant up to the present moment have established that oil can be recovered from the Alberta Oil Sands on a continuous basis using the Hot Water Separation Process. Definite information on such points as mining methods, personnel requirements, equipment sizes and operating conditions has been obtained. Equipment, capable of coping with the rather unusual erosion problems encountered during separation, has been found and proven in actual operation. In

short the present arrangement constitutes a satisfactory working unit. This opinion is shared by impartial technical observers who have visited the plant. It is true that certain processing losses occur which it would be desireable to eliminate so that maximum efficiency could be achieved but it is equally certain that future technological advances will accomplish this. It should also be reiterated that winter mining will undoubtedly present difficulties but these are not visualized as insurmountable or as greatly affecting the cost of operation.

In addition to the Hot Water Separation Process being employed at Bitumount the Bureau of Mines and the National Research Council at Ottawa are working on two processes, both of which show great promise at their present stages of development. Both processes have been operated successfully on a pilot plant scale but it would be highly desirable to demonstrate both operations on a semi-commercial scale (400 - 500 tons per 24 hours).

A complete description of either process is beyond the scope of this report. Briefly, however, the Bureau of Mines process is a cold water flotation method utilizing a petroleum distillate or diluent to facilitate separation and flotation. Recoveries appear to be higher than those obtained at Bitumount and it has the added advantage of operating at room temperature with proportionate heat savings. The National Research Council are using an adaptation of the Fluidized Bed Technique to accomplish direct distillation of the oil from the sand in a fluidized bed. Spent sand leaving the still or retort is covered with a fine layer of coke which is burned off to supply heat to the still by recirculating part of the high temperature sand. This process has the important advantage that the oil produced is much higher in gravity and lower in viscosity than produced by either of the flotation processes. This factor is of course extremely important from the point of view of transporting the oil to its ultimate point of utilization.

To fully evaluate either of these processes would require operating them on a scale comparable to that on which the Hot Water Process has been operated at Bitumount. In view of the fact that the common aim of all interested parties is the ultimate utilization of the Oil Sands it would seem that some co-operative undertaking is called for at this time. Since the Oil Sands Project has available certain equipment and facilities adaptable to any process, it would not appear to be in the best interest of anyone concerned to duplicate these things at another location in order to test alternative processes. It should also be pointed out that the Oil Sands Project could contribute considerable know how on such points as transportation and the construction and operation of plants in this locality. The making of these things available to a joint undertaking would considerably facilitate the demonstration of these processes.

While it can be stated that oil is now available from Oil Sands by use of the Hot Water Process, no final estimate of the present competitive position can be made until these new processes are fully tested. Even when accurate operating data on all three methods is available much additional information would be required before a price for oil sand crude can be developed which would permit a sensible comparison with crude from usual sources. In general it would involve the answering of the following questions.

1. What will it cost to produce oil from oil sands on a large scale? A reasonable estimate of this figure could be arrived at by projecting information obtained from semi-commercial operation of the three available processes. In such a projection it should be recognized that other types of equipment might be used which would not be practical on a small scale. It would also be desirable to develop at least preliminary designs for the large scale units in order to anticipate the mechanical limits of equipment sizes and to permit reasonably accurate estimates of the investment required.

2. The cost of converting the heavy viscous oil sand crude into a product which would be readily transportable and which would be acceptable as refinery charge stock. At this stage consideration would have to be given to the fact that the product of the Fluidized Bed Process approaches these requirements. Detailed economic studies of all suitable and available refinery techniques such as coking, hydrogenation, propane deasphaltizing, etc., would also be necessary including actual operating data on these various methods. An examination of the products obtained would then have to be made with a view to choosing the one which would give the largest net return when delivered to the prospective refiner.

3. Finally a survey of the available markets should be made plus an estimate of the cost of constructing and operating a pipe line capable of transporting the processed crude to the most desirable marketing area.

With detailed information on the foregoing available it would be possible to decide the present competitive position of Oil Sands as a source of petroleum and to forecast when they could be profitably exploited. The information obtained during such a survey would also add considerably to the data now available and provide the ground work for rapid development if this oil were suddenly required. This last feature cannot be too highly emphasized.

In addition to completing studies of the Cold Water and Fluidized Bed Methods, a comprehensive treatment of the studies briefly outlined above would require the services of several qualified technicians plus at least pilot plant equipment capable of supplying the necessary production data on conversion and refining.

There are two ways in which such a program can be handled. The first and obviously the most expensive method would be for the Oil Sands Project to obtain the necessary technicians, erect the necessary equipment and proceed with the investigation. This might prove exceedingly difficult especially the procurement of qualified technicians. It would also require considerable additional capital outlay for equipment. Finally there is no doubt but that much duplication of existing facilities and current work would result.

An alternative method would be to enter into a co-operative arrangement with the Bureau of Mines and the National Research Council to ensure completion of their studies with the least delay and expense. This would make available much more comprehensive data as the basis for a complete survey than is existant at the moment. Further since both the Bureau of Mines and the National Research Council have extensive laboratory facilities they could contribute much on fundamental problems in connection with refining, treating, etc.

The second stage would be to retain a research and development company or companies who already possess the organization necessary to co-ordinate the whole survey and the pilot plant facilities required to make the necessary studies on conversion and refining. The combining of all the information and experience from actual field trials with their special knowledge of large scale mining, processing and refining should permit completion of the whole picture.

Due to the number and complexity of the problems in connection with the development of Oil Sands, it is doubtful if any one company would have on their regular staff experts on all the related subjects. For this reason it may be difficult to find one group who would care to accept responsibility for the whole program. If this is the case, it would be possible to divide the work between two or three firms and then co-ordinate the information obtained from each.

The consideration at present being given by the Board of Trustees to the retaining of an independent consulting engineer to

co-ordinate all presently available information is a step in the direction suggested.

Should further plant scale studies of the Hot Water Process be considered necessary it has been pointed out that certain minimum extensions will have to be made as follows.

1. Provision of an adequate water supply.
2. Provision of at least earthen pits for storing surplus residual oils.
3. Provision of means for tailings disposal.

This would also apply if Bitumount were decided upon as the site for plant scale demonstrations of the processes being developed in Ottawa. Further as long as there appears any chance of the three foregoing possibilities it would seem essential that the present plant be kept in top mechanical condition and that studies now underway to improve the efficiency of the Hot Water Process be continued.

It is recommended that some immediate action be taken to obtain the full co-operation of all parties interested in Oil Sand Development to the extent of joint financial support if possible. It is also suggested that consideration be given to the possibility of including industry. Recently there has been the best of relations and the freest exchange of information but it is felt that the basis of co-operation should be established at a higher executive level.

WINTER PROGRAM 1949 - 50

Since the suspension of operations on September 30, 1949, an extensive inspection of all plant equipment has been made. Appropriate measurements were taken to determine the amount of wear and repairs are being made where indicated.

In addition to maintenance work an experimental crusher has been built to study the sizing of mine run material in cold weather. This crusher is now complete and will be in operation in January 1950. It has two toothed rolls 24" long and 18" in diameter. One roll is fixed and the other is movable. The amount of movement on the floating roll can be controlled by adjusting the tension on a pair of coil springs. During the initial runs it is proposed to operate the crusher at 100 R.P.M. Power is to be supplied by a six cylinder gasoline engine.

Undoubtedly several modifications to the initial set up will have to be made before a satisfactory working unit is developed. It is hoped, however, that by spring sufficient information will be available to permit design of a suitable crusher capable of handling the whole plant throughput.

In addition to the experimental work on crushing it is also proposed to investigate actual mining problems in so far as the limited staff at the plant are able. The effectiveness of pneumatic tools will be determined and some blasting will be done. Present indications are that the Power Shovel would be unable to excavate economically in the winter without some drilling and blasting being done simultaneously.

GENERAL INFORMATION

1. Transportation.

During 1949 the airstrip at the plant was extended to give a

total runway length of 3200 feet. This permits the handling of twin motored aircraft. Practically all air travel in and out of the plant was handled by government owned aircraft effecting a considerable saving over past years when commercial aircraft were used exclusively.

Due to the fact that little heavy equipment was being moved to the plant site by water during 1949, a smaller and lighter barge was needed to reduce operating costs per trip. A combination freight and passenger barge was built at the plant to fill this need. It is capable of handling approximately 20 tons of small freight and six to eight passengers in reasonable comfort. Due to its light weight and shape the travelling time between Waterways and Bitumount has been substantially reduced.

It should also be mentioned that the snowmobile purchased late in 1948 performed very satisfactorily during the winter months of 1949. It is capable of making the trip from Bitumount to McMurray in approximately 2½ hours and handles loads up to 2,500 pounds.

2. Camp Operation.

Despite the fact that the charge for board and room was raised to $2.00 per day in March of 1949, a loss of $6500 was experienced on camp operations for the year. This covered all expenditures including camp maintenance, laundry, etc. Maximum number living in the camp was fifty-two.

3. Safety.

The 1949 safety record was the poorest since the inception of the project. This was due to two serious cases of burns both of which required extended hospitalization. There were no other lost time accidents.

As has been pointed out previously practically all employees on the project have had no previous experience in industries utilising high temperatures and pressures and considerable experience and instruction is required to fully acquaint the employees with the inherent hazard of their work.

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Alberta, Oil Sands Project.